

AMENDMENTS TO THE CLAIMS

1. (Currently amended) A process for producing a monolithic ceramic electronic component, which comprises:

- forming a ceramic paste by
 - dispersing a first mixture comprising ceramic powder and a first organic solvent in the absence of an organic binder to provide a primary dispersion,
 - dispersing a second mixture comprising an organic binder, a second organic solvent and the primary dispersion to provide a secondary dispersion,
 - wherein a the second organic solvent ~~having~~ has a relative evaporation rate lower than that of the first organic solvent ~~is incorporated into at least one of the first mixture and the second mixture,~~
 - and selectively removing the first organic solvent from the second mixture;
- forming a plurality of composite structures by shaping a ceramic slurry to form a ceramic green sheet having a main surface, applying said conductive paste onto the main surface of the ceramic green sheet so as to provide step-like sections of an internal circuit element film, and applying a ceramic paste onto the region on the main surface of the sheet on which the element film are not formed so as to substantially compensate for the spaces defined by the step-like sections and form a ceramic green layer;
- forming a green laminate by laminating a plurality of the composite structures; and
- firing the green laminate.

2. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the first mixture comprises an organic dispersant.

3. (Original) A process for producing a monolithic ceramic electronic component according to claim 2, wherein the organic dispersant is about 0.1 to 5 wt. % based on the ceramic powder.

4. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the first organic solvent has a relative evaporation rate of at least about 100 at 20°C, and the second organic solvent has a relative evaporation rate of less than about 50 at 20°C.

5. (Original) A process for producing a monolithic ceramic electronic component according to claim 4, wherein the first organic solvent has a relative evaporation rate of at least about 150 at 20°C.

6. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the forming of the ceramic paste further comprises filtering the secondary dispersion before the removal of the first solvent.

7. (Original) A process for producing a monolithic ceramic electronic component according to claim 6, wherein the organic binder is dissolved in at least one of the first organic solvent and the second organic solvent to thereby form an organic vehicle; and the organic vehicle is filtrated.

8. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the first organic solvent has a boiling point lower than that of the second organic solvent.

9. (Original) A process for producing a monolithic ceramic electronic component according to claim 8, wherein difference between the boiling point of the first organic solvent and that of the second organic solvent is about 50°C or more.

10. (Original) A process for producing a monolithic ceramic electronic component according to claim 9, wherein the boiling point of the second organic solvent is at least about 150°C.

11. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the ceramic slurry and ceramic paste each comprises a ceramic powder of substantially the same composition.

12. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the ceramic powder contained in each of the ceramic slurry and the ceramic paste is a dielectric ceramic powder.

13. (Original) A process for producing a monolithic ceramic electronic component according to claim 12, wherein the internal circuit element films are arranged so as to form internal electrodes and to provide capacitance between a pair of electrodes, and the monolithic ceramic electronic component is a monolithic ceramic capacitor after firing the green laminate.

14. (Original) A process for producing a monolithic ceramic electronic component according to claim 1, wherein the ceramic powder contained in each of the ceramic slurry and the ceramic paste is a magnetic ceramic powder.

15. (Original) A process for producing a monolithic ceramic electronic component according to claim 14, wherein the internal circuit element films are curved and disposed so as to form a monolithic inductor when the green laminate is fired.

17. (Currently amended) A process for producing a ceramic paste, which comprises:

dispersing a first mixture comprising ceramic powder and a first organic solvent in the absence of an organic binder to provide a primary dispersion;

dispersing a second mixture comprising an organic binder, second organic solvent and the primary dispersion to provide a secondary dispersion;

wherein ~~a~~ the second organic solvent ~~having~~ has a relative evaporation rate lower than that of the first organic solvent ~~is incorporated into at least one of the first mixture and second mixture; and~~

removing the first organic solvent from the second mixture.

18. (Original) A process for producing a ceramic paste according to claim 17, wherein the first organic solvent has a relative evaporation rate of at least about 100 at 20°C, and the second organic solvent has a relative evaporation rate of less than about 50 at 20°C.

19. (Original) A process for producing a ceramic paste according to claim 17, wherein the first organic solvent has a boiling point lower than that of the second organic solvent.

REMARKS

Prior to the present amendment, the claims recited a process in which the second organic solvent having a relative evaporation rate lower than that of the first organic solvent was incorporated into at least one of the first and second mixtures. In order to expedite allowance of this application, the claims have now been limited to the processes in which the second organic solvent constitutes a part of the second mixture.

Claims 1-13 and 17-19 were rejected under 35 U.S.C. 103 over JP '925 in view of GB '211 or Takeuchi, while Claims 14 and 15 were rejected under 35 U.S.C. 103 over the same combination of references in further view of Tokuda. Both of these rejections are respectfully traversed.

Monolithic ceramic electronic components which are formed from a plurality of ceramic layers and which include internal circuit element films have an inherent problem due to the step portions which result from that construction. There is a difference in thickness at points in the part and as the size of the individual layers is reduced, the difference in thickness becomes more apparent. An additional ceramic material has been used to overcome this problem in order to substantially compensate for the spaces defined by the step like sections formed by the internal film on the ceramic sheets. That compensating materials is obtained by applying a ceramic paste containing a ceramic powder, binder, plasticizer and organic solvent. The dispersability of the ceramic powder in the ceramic paste must be high in order to form a printing layer which has both a high accuracy and a desired thickness such as, for instance, 2 μm or less. The art has developed a number of methods to accomplish this result.

The primary reference in both rejections, JP '925, represents one method of addressing the problem. This reference teaches making a slurry by mixing a ceramic powder, binder and first organic solvent, mixing the resulting slurry with a second organic solvent and then heating the resulting mixture so as to remove one of the solvents. This procedure does improve the dispersability of the ceramic powder to some extent but since

the paste contains the organic binder, the viscosity becomes high during the mixing process and that imposes a limitation on the ability to improve the dispersability of the ceramic powder.

The present invention is based on the surprising discovery that the process of JP '925 could achieve a paste of suitable viscosity if the introduction that the binder was delayed until after the primary dispersion of the ceramic powder and the less volatile boiling point organic solvent had been achieved. That is not described in the primary reference and the deficiency is not obviated by the secondary references.

The teachings of JP '925 have been discussed in the present application as well as noted above. As the Examiner has pointed out, it discloses a process of mixing a ceramic powder, binder and first organic solvent followed by adding a second solvent having a higher boiling point and then removing the first solvent. By so acting, the character of the resulting paste becomes the same as the character of the dielectric powder used in the dielectric slurry to form the individual plies of the product, so that the sintering properties of each layer and the thickness adjustment layers become the same. The present invention differs from this procedure in that the binder is not added when a first dispersion is made with the ceramic powder and the first organic solvent and in that the binder and second organic solvent are added together in a later step. As a result, the viscosity of the paste is controlled. There is no teaching or suggestion in JP '925 concerning the control of the viscosity of the paste in the manner claimed. As to claim 6, there is a further difference in that there is no teaching or suggestion in JP '925 of filtering the secondary dispersion (containing the binder) before the first solvent is eliminated from the composition.

The deficiencies in JP '925 are not cured by the secondary references.

GB '211 relates to method of forming complex shapes with a refractory material by forming slurry of the refractory material, binder, plasticizer and a single solvent. In an example, the refractory material is wet milled with the same solvent used in the slurry before the binder and plasticizer are added. The purpose of the wet milling is to make the

refractory material a desired size. The Takeuchi reference has a similar disclosure, as noted by the Examiner. Both of these references show ball milling to break up a material before forming a slurry paste. Both teach using the same solvent as will be present in the paste when used. Neither teaches nor suggests that the late introduction of the binder affects the viscosity of the paste when a two solvent method is employed. Also, nothing in the combination teaches or suggests the filtering of the secondary dispersion before selective removal of the first solvent is begun.

Assuming that one skilled in the art would want to perform wet milling for the reasons advanced in the Office Action, which is a different motivation than in the present invention, then it is contraindicated to mill in the first organic solvent. The paste product of the Japanese reference is a combination of ceramic, binder and higher boiling point solvent since the lower boiling point solvent is driven off. To mill in the solvent desired to be present in the final paste means that the material will be milled in the second solvent. Milling in the low boiling point organic solvent (the first solvent), as in the present invention, does not make logical sense since that means that the milled ceramic would have to be transferred from dispersion in the first organic solvent to the dispersion in the second organic solvent whereas if the milling took place in the second organic solvent, no such transfer would be required. Moreover, the heat generated during milling could result in driving off at least some of the first organic solvent. Thus, even if one were to assume that there was a reason to wet mill before adding the binder in a two solvent process, the wet milling would take place in the solvent intended to remain in the product at the end of the process, namely the higher boiling point solvent. That is not the claimed process.

The additional reference, Takuda, which has been cited only against claims 14 and 15, does not overcome any deficiency in the combination of JP '925, GB '211 and Takeuchi. Takuda has been relied on only to show an inductor and does not teach or suggest preliminary wet milling in a lower boiling point organic solvent. It's a combination with the other references, therefore, cannot render the claimed invention obvious.

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In light of all of the foregoing, it is respectfully submitted that this application is now in condition to be allowed and the early issuance of a Notice of Allowance is respectfully solicited.

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